BROOKHAVEN NATIONAL LABORATORY

Work Permit # DRL-2011-011/SS-2011-
Work Order # _____
Job# _____ Activity# _____

1. Work requester fills out this section. ☐ **Standing Work Permit**

Requester: Don Lynch	Date: 07/29/11	Ext.: 2253	Dept/Div/Group: PO/PHENIX
Other Contact person (if different from requester): Carter Biggs			Ext.: 7515
Work Control Coordinator: Don Lynch		Start Date: 08/1/11	Est. End Date: 12/31/11
Brief Description of Work: Install RPC1 Detector modules and supporting services			
Building: 1008	Room: IR	Equipment: RPC1 subsystem	Service Provider: PHENIX techs

. WCC, Requester/Designee, Service Provider, and ES&H (as necessary) fill out this section or attach analysis

ES&H ANALYSIS				
Radiation Concerns	☒ None	☐ Activation	☐ Airborne	☐ Contamination	☒ Radiation
Radiation Generating Devices:	☐ Radiography	☐ Moisture Density Gauges	☐ Soil Density Gauges	☐ X-ray Equipment
☐ Special nuclear materials involved, notify Isotope Special Materials Group			☐ Fissionable materials involved, notify Laboratory Criticality Officer	

Safety Concerns				
	☐ None	☐ Ergonomics	☐ Transport of Haz/Rad Material	
☐ Adding/Removing Walls or Roofs	☐ Confined Space*	☐ Explosives	☒ Lead*	☐ Penetrating Fire Walls
	☐ Corrosive	☐ Flammable	☐ Magnetic Field*	☐ Pressurized Systems
☐ Asbestos*	☐ Cryogenic	☐ Fumes/Mist/Dust*	☒ Material Handling	☒ Rigging/Critical Lift
☐ Beryllium*	☐ Electrical	☐ Heat/Cold Stress	☐ Noise*	☐ Toxic Materials*
☐ Biohazard*	☒ Elevated Work*	☐ Hydraulic	☐ Non-ionizing Radiation*	☐ Vacuum
☐ Chemicals*	☐ Excavation	☐ Lasers*	☐ Oxygen Deficiency*	☐ Other
* Does this work require medical clearance or surveillance from the Occupational Medicine Clinic? ☐ Yes ☒ No				

Environmental Concerns			
	☒ None	☐ Work impacts Environmental Permit No.	
☐ Atmospheric Discharges (rad/non-rad)	☐ Land Use	☐ Soil Activation/contamination	☐ Waste-Mixed
☐ Chemical or Rad Material Storage or Use	☐ Liquid Discharges	☐ Waste-Clean	☐ Waste-Radioactive
☐ Cesspools (UIC)	☐ Oil/PCB Management	☐ Waste-Hazardous	☐ Waste-Regulated Medical
☐ High water/power consumption	☐ Spill potential	☐ Waste-Industrial	☐ Underground Duct/Piping
Waste disposition by:			☐ Other
Pollution Prevention (P2)/Waste Minimization Opportunity:	☒ None ☐ Yes		

FACILITY CONCERNS			
	☒ None		
☐ Access/Egress Limitations	☐ Electrical Noise	☐ Potential to Cause a False Alarm	☐ Vibrations
	☐ Impacts Facility Use Agreement	☐ Temperature Change	☐ Other
☐ Configuration Control	☐ Maintenance Work on Ventilation Systems	☐ Utility Interruptions	

WORK CONTROLS				
Work Practices				
☐ None	☐ Exhaust Ventilation	☒ Lockout/Tagout	☐ Spill Containment	☐ Security (see Instruction Sheet)
☒ Back-up Person/Watch	☐ HP Coverage	☐ Posting/Warning Signs	☐ Time Limitation	☐ Other
☐ Barricades	☐ IH Survey	☐ Scaffolding-requires inspection	☐ Warning Alarm (i.e. "high level")	
Protective Equipment				
☐ None	☐ Ear Plugs	☐ Gloves	☐ Lab Coat	☒ Safety Glasses
☐ Coveralls	☐ Ear Muffs	☐ Goggles	☐ Respirator	☒ Safety Harness
☐ Disposable Clothing	☐ Face Shield	☒ Hard Hat	☐ Shoe Covers	☒ Safety Shoes ☐ Other
Permits Required (Permits must be valid when job is scheduled.)				
☒ None	☐ Cutting/Welding	☐ Impair Fire Protection Systems		
☐ Concrete/Masonry Penetration	☐ Digging/Core Drilling	☐ Rad Work Permit-RWP No		
☐ Confined Space Entry	☐ Electrical Working Hot	☐ Other		
Dosimetry/Monitoring				
☒ None	☐ Heat Stress Monitor	☐ Real Time Monitor	☐ TLD	
☐ Air Effluent	☐ Noise Survey/Dosimeter	☐ Self-reading Pencil Dosimeter	☐ Waste Characterization	
☐ Ground Water	☐ O_2/Combustible Gas	☐ Self-reading Digital Dosimeter	☐ Other Check O2 level prior to entry	
☐ Liquid Effluent	☐ Passive Vapor Monitor	☐ Sorbent Tube/Filter Pump		

Training Requirements (List below specific training requirements)

CA –Collider User, PHENIX Awareness, Working at heights, rigging

Based on analysis above, the Walkdown Team determines the risk, complexity, and coordination ratings below:				**If using the permit when all hazard ratings are low, only the following need to sign: (Although allowed, there is no need to use back of form)**	
ES&H Risk Level:	☐ Low	☒ Moderate	☐ High	WCC:	Date:
Complexity Level:	☒ Low	☐ Moderate	☐ High	Service Provider:	Date:
Work Coordination:	☒ Low	☐ Moderate	☐ High	Authorization to start	Date:
				(Departmental Sup/WCC/Designee)	

3. Both work requester and service provider contribute to work plan (use attachments for detailed plans)

Work Plan (procedures, timing, equipment, and personnel availability need to be addressed): The tasks described in this WP complete the Muon Trigger RPC PHENIX detector subsystem installation. These are related to a share common gas distribution system with the RPC3 north and south detector subsystems installed during the 2009 and 2010 shutdowns respectively. Details of the installation procedure and illustrations for the installation plan are attached.
Special Working Conditions Required: None
Operational Limits Imposed:
Post Work Testing Required: No

Job Safety Analysis Required: ☐ Yes ☒ No	Walkdown Required: ☒ Yes ☐ No

Reviewed by: Primary Reviewer will determine the size of the review team and the other signatures required based on hazards and job complexity. Primary Reviewer signature means that the hazards and risks that could impact ES&H have been identified and will be controlled according to BNL requirements.

Title	Name (print)	Signature	Life #	Date
Primary Reviewer				
ES&H Professional				
Other				
Other				
Work Control Coordinator	Don Lynch		20146	
Service Provider				
	Review Done: ☐ in series	☐ team		

4. Job site personnel fill out this section.

Note: Signature indicates personnel performing work have read and understand the hazards and permit requirements (including any attachments).			
Job Supervisor:		Contractor Supervisor:	
Workers:	Life#:	Workers :	Life#:
Workers are encouraged to provide feedback on ES&H concerns or on ideas for improved job work flow. Use feedback form or space below.			

5. Departmental Job Supervisor, Work Control Coordinator/Designee

Conditions are appropriate to start work: (Permit has been reviewed, work controls are in place and site is ready for job.)			
Name:	Signature:	Life#:	Date:

6. Departmental Job Supervisor, Work Requester/Designee determines if Post Job Review is required. ☐ Yes ☐ No

Post Job Review (Fill in names of reviewers)			
Name:	Signature:	Life#:	Date:
Name:	Signature:	Life#:	Date:

7. Worker provides feedback.

Worker Feedback (use attached sheets as necessary)
a) WCM/WCC: Is any feedback required? ☐ Yes ☐ No

b) Workers: Are there better methods or safer ways to perform this job in the future? ☐ Yes ☐ No

8. Closeout: Work Control Coordinator (authorizing dept.) checks quality of completed permit and ensures the work site is left in an acceptable condition. (WCC can delegate clean up of work area to work supervisor)

Name:	Signature:	Life#:	Date:
Comments:			

Attachment to W.P. #DRL-2011-011/SS-2011-

Installation of RPC1 Detector Subsystems and Supporting Services in the North and South "Flowerpot" Cavities of the PHENIX Central Magnet

Introduction

During the summer 2011 shutdown maintenance period PHENIX will complete the new Reactive Plate Chamber (RPC) detector subsystem with the installation of 2 additional stations of RPC detectors in the station 1 north and south areas of the PHENIX central magnet (CM) vicinity. These detectors will be installed in the so-called "flower pot" cavities on the north and south side of the PHENIX CM. Together with the existing RPC3 north and south subsystems, the Muon Tracker and the Muon Trigger Front end electronics recent upgrade, these subsystems will allow for improved particle detection, tracking and timing for collision particles in the forward direction.

I. Design

The new RPC1 detectors are arranged in 360 degree array around the beampipe in both the north and south station 1 areas of PHENIX as described above. The north and south subsystems are identical and each is comprised of 8 octant independently mounted and aligned detector modules. Each module contains 2 gas moderated active detectors known as "gaps", which are sealed modules which generate precise signals as the tracked particles pass through. The signals are processed electronically by local electronics on each module and the signal routed first to identical north and south rack mounted processing electronics located on the CM bridge platform. From there the processed signals are routed via fiber optic cables to data processing and analyses in rack mounted electronics in the PHENIX rack room and to the PHENIX data acquisition system (DAQ).

High voltage support for the detector modules, low voltage for module level electronics are routed from the bridge racks to the detector and managed in cable trays. Gas services to the detector modules are provided via a gas distribution manifolds, flow meters and polyflow distribution tubing, sourced from the existing RPC gas system control rack (already in place in the PHENIX gas mixing house. The details of the support structure and services design are documented in PHENIX controlled drawings. The design is illustrated in the RPC1 illustrated installation plan (attached). Each module octant weighs less than 50 lbs. and will be installed by PHENIX technicians accessing the area with scaffolding. (Note: the scaffolding used has been designed for general purpose use in the station 1 areas of PHENIX, and will already be in place due to Muon Tracker subsystem maintenance also taking place this shutdown. The scaffolding is fully described in the work permit for that project and which is referenced herein.)

II. Fabrication

Fabrication of the Detector modules is occurring in the PHENIX RPC Factory at BNL. The RPC group of PHENIX will be assembling the individual modules and performing appropriate tests at the PHENIX RPC Factory. The work performed therein is described and documented in the RPC Factory workplan, an approved and controlled document in the PHENIX controlled procedure system and is available from PHENIX engineering.

III. Procedure

This work is to be done by fully trained and experienced personnel (PHENIX mechanical technicians) during the 2011 maintenance shutdown prior to RHIC run 12.

Prior to installation:

1. Read and understand all components of the work permit and attachments for this installation effort.

2. Cover the exposed section of beampipe on the north side of the CM flowerpot area with thick foam insulation. In conjunction with the scaffolding erected for work this summer a rigid mechanical barrier is to be erected around the foam covered beampipe. Verify that the rigid barrier is in place before proceeding with the installation. This barrier shall remain in place during the entire installation.

3. Each module shall be pre-surveyed at the RPC factory with appropriate precision positional targets referenced to internal detector module fiducials (To be established by the RPC group and BNL surveyors.)

4. Each module will be delivered to the PHENIX IR from the RPC factory via PHENIX vehicles with appropriate measures taken to minimize jostling during delivery.

5. The scaffolding shall be in the lower work platform configuration prior to commencing the installation. (Refer to the scaffolding portion of the MuTr work permit referenced above for details.)

6. Using the octant template, pre-position the inner ring supporting bracket and verify that the ring is positioned such that the octants will be precise aligned in their design position and concentric with the beamline center.

RPC1 Detector Installation

1. One at a time beginning with the lower most octant, using appropriate slings, lift the octant to the work platform where it will be received by 2 PHEIX technicians for

installation.

2. Technicians shall lift the octant by hand and position it in its respective position, aligned by the inner support ring.

3. The outer and inner mechanical support and alignment bracketry shall be attached per the appropriate drawings.

4. After each day of installation, RPC experts shall perform QA tests to verify that the newly installed octants are functioning correctly. Should any anomaly be detected, the experts shall determine whether a repair in place or remove and repair action is necessary. This shall be documented and attached to the work permit. If such action is more than a low risk, low complexity and/or low coordination level of effort as determined by the designated work coordinator, CAD safety shall be consulted for approval of such effort.

5. After the bottom five octants have been installed, the scaffolding shall be re-configured to the upper work platform configuration. (Refer to the scaffolding portion of the MuTr work permit referenced above for details.)

6. After all octants are installed, BNL survey group shall survey each module using the pre-established reference targets and determine the 3-D position of each octant with respect to the established PHENIX control survey markers. These shall establish the relative position of each module radially and circumferentially with respect to the nominal beam path and longitudinally with respect to the nominal PHENIX interaction point (IP) as precisely as possible. This information shall be immediately conveyed to PHENIX technicians.

7. PHENIX technicians and engineers shall re-align the individual octants using the mechanical supporting hardware's slotted features.

8. BNL surveyors shall re-survey each octant.

9. Repeat steps 5 and 6 until the octants are aligned as symmetrically positioned as possible, circumferentially (with respect to a horizontal axis through the center of the nominal beam path), radially with respect to the nominal beam path and longitudinally with respect to the nominal IP and such that each octant is as co-planar with the plane perpendicular to the nominal beam path.

10. Attach the appropriate cables, gas piping, fibers etc. and route as appropriate in accordance with the attached RPC1 illustrated installation plan and best PHENIX worker planned work practices.|

11. RPC Group experts shall then commence full system QA testing to commission and adjust the operation of the new subsystem. This effort shall be worker planned work.

V. Work conclusion

When all work described in this work permit has been completed, the PHENIX work coordinator for this set of tasks shall collect feedback from all parties (PHENIX engineers and technicians and RPC experts). This feedback shall include critical review of any problems encountered during installation, solutions to such problems, changes to work procedures described herein during the conduct of this work, suggestions for improvements in equipment procedures and techniques and any other information deemed useful and/or relevant by the PHENIX work control coordinator. Such information shall be appropriately disseminated to the various affected/interested parties and a copy of this information shall be attached to this work permit when it is closed out. Any lessons learned shall be applied to future installations and/or maintenance/upgrades for this and similar projects.

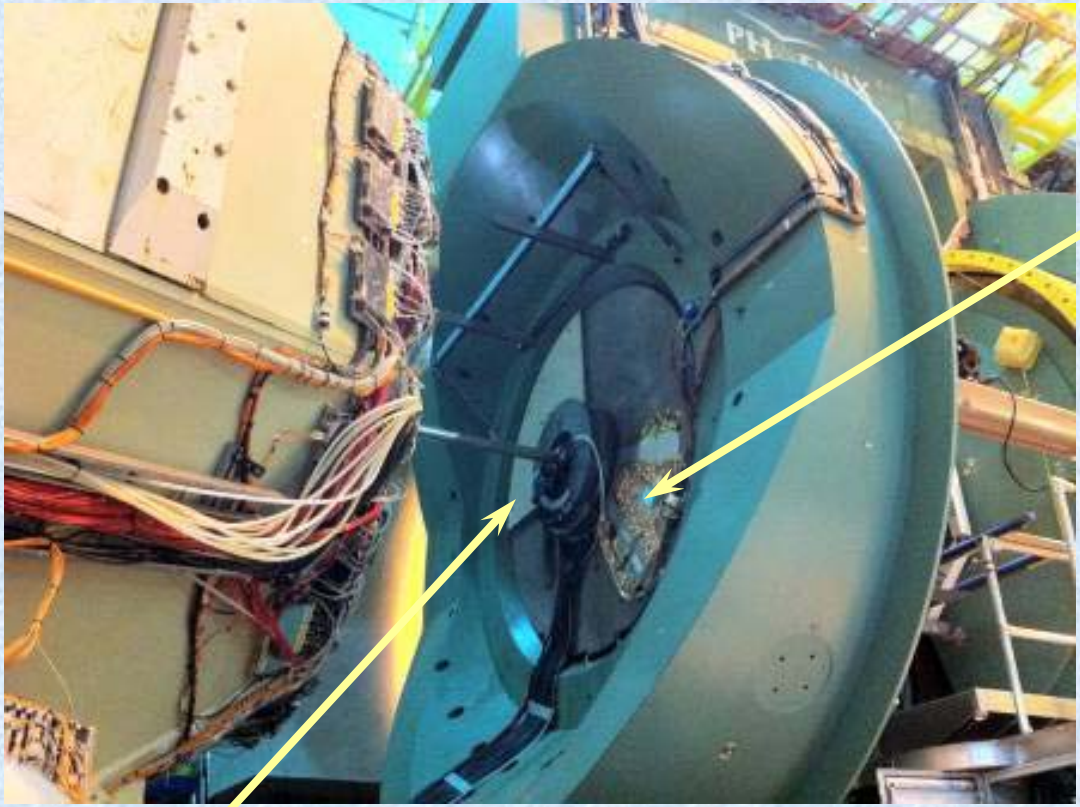
Illustrated Installation Plan
For
RPC1 PHENIX Detector Subsystem

RPC1 detectors are fabricated as 8 identical octants and are the same on both the north and south.

Steel absorbers installed during shutdown 2010 proved to be beneficial during run 11 and will remain in place unchanged. PE and Pb absorber testing of prototype during run 11 indicated negligible benefit of absorbers as originally planned. Therefore no PE nor Pb absorbers are to be installed.

Individual octants weigh less than 50 lbs each and shall be individually installed and mounted by hand. IR Crane and appropriate slings may be utilized to stage the individual octants.

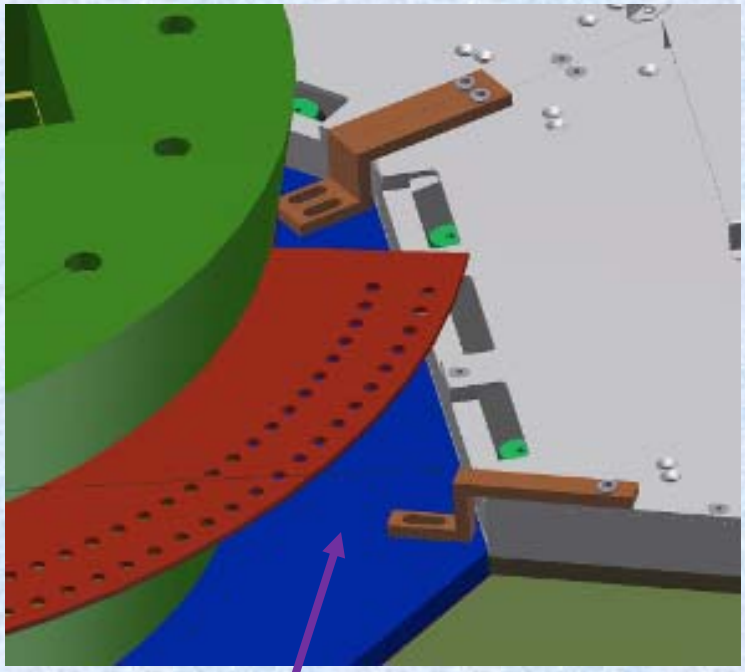
Work platforms installed for MuTr work will be utilized for RPC1 Installation.



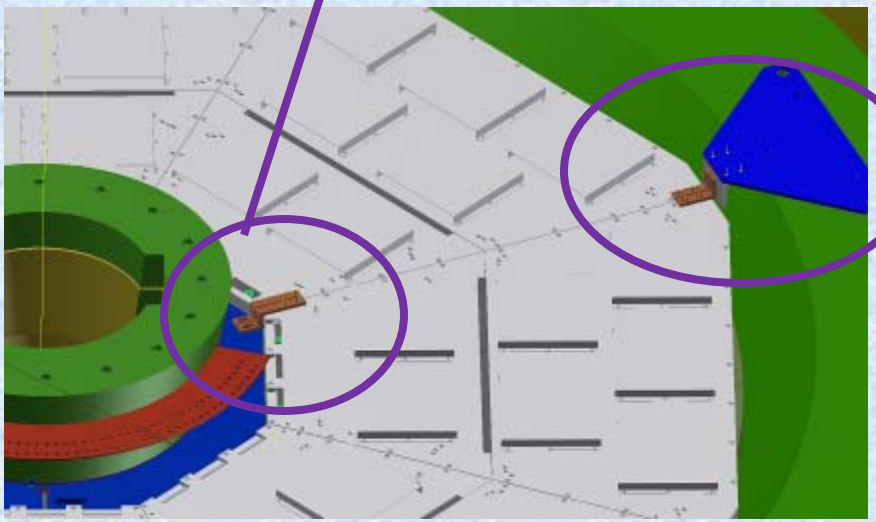
RPC1 prototype installed in the south CM station 1 flowerpot area. The prototype and its services have been removed from this areaThe RPC1 south detector octants will be installed in this area. The RPC1 north detector octants will be stored in the similar location on the north side of the CM.

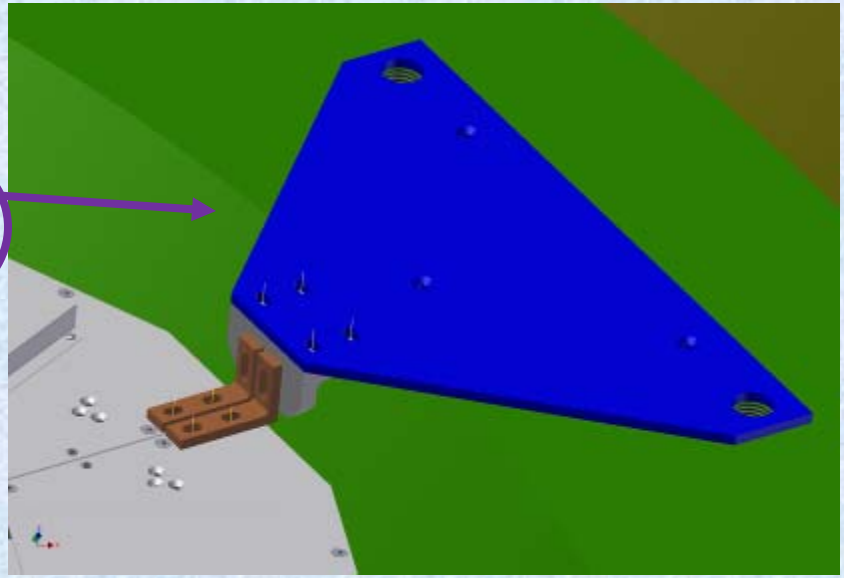
RPC1 prototype PB and borated PE absorbers installed in the south CM station 1 flowerpot area. These absorbers and supporting hardware have been removed from this area. Absorbers of this type have been determined to be unnecessary for the new RPC1 .

RPC1 Mounting Concept



Octants are individually mounted then tied together and supported at the outer octant boundaries by brackets mounted on existing tapped holes, and on inner edges by rings which wedge against the flower pot lead liner. Tapped holes in 8 places on each octant are used both to mount the absorber section and to attach the mounting brackets.

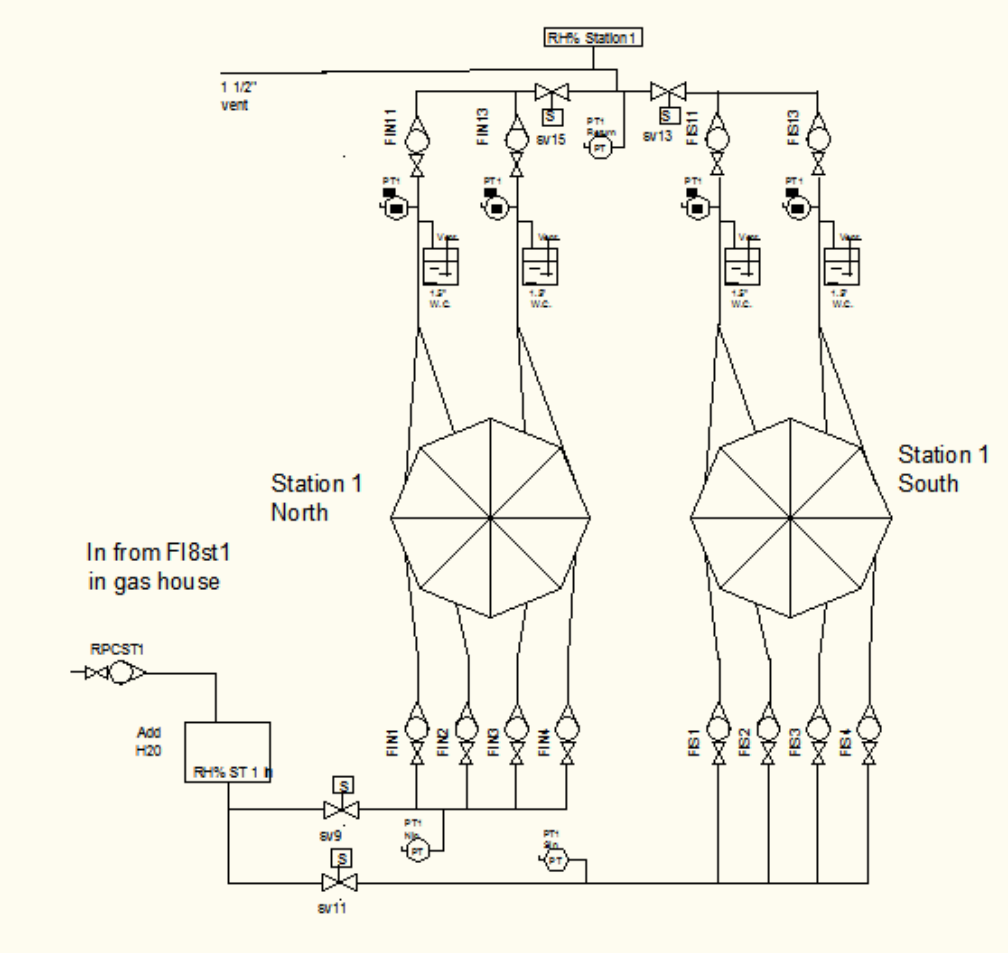




RPC1 Electronics

- Add one PHENIX electronics rack to bridge – CMT6.
- Add three more FEE crates, one for south (CMT1) and two for north (CMT6) .
- Four FEE boards per octant. Total: 16 FEE boards in each of 4 crates.
- Install 16 LV cables: 8 south and 8 north.
- Install 256 signal cables: 16 per octant per side.
- All new components are the same as previously approved RP3 installations.

RPC1 Distribution System



RPC1 channel in the gas house and gas lines to the Central Magnet already exists (old HBD lines). They were already used to run the RPC1 prototype for Run 11

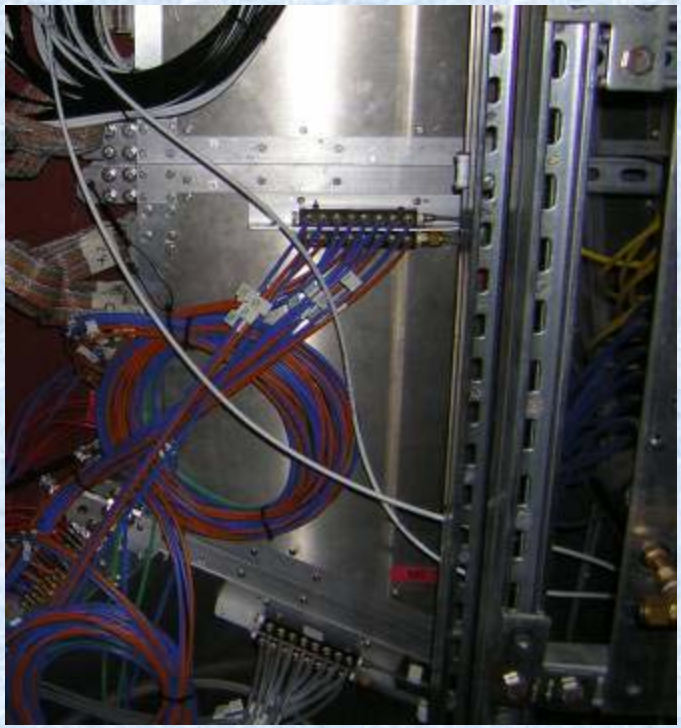
Current RPC1 Prototype rack

RPC1 South Panel

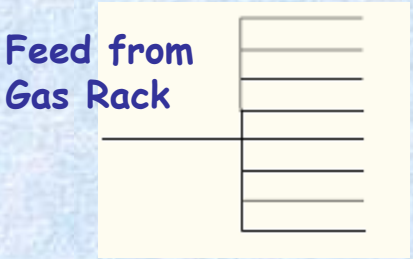
RPC1 North Panel

Cooling System

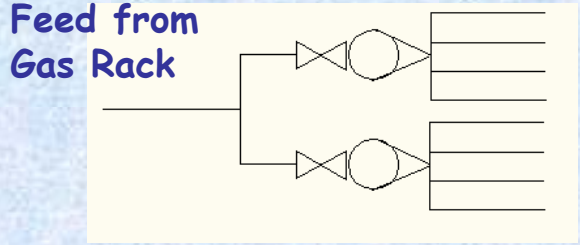
RPC3 Distribution Upgrade



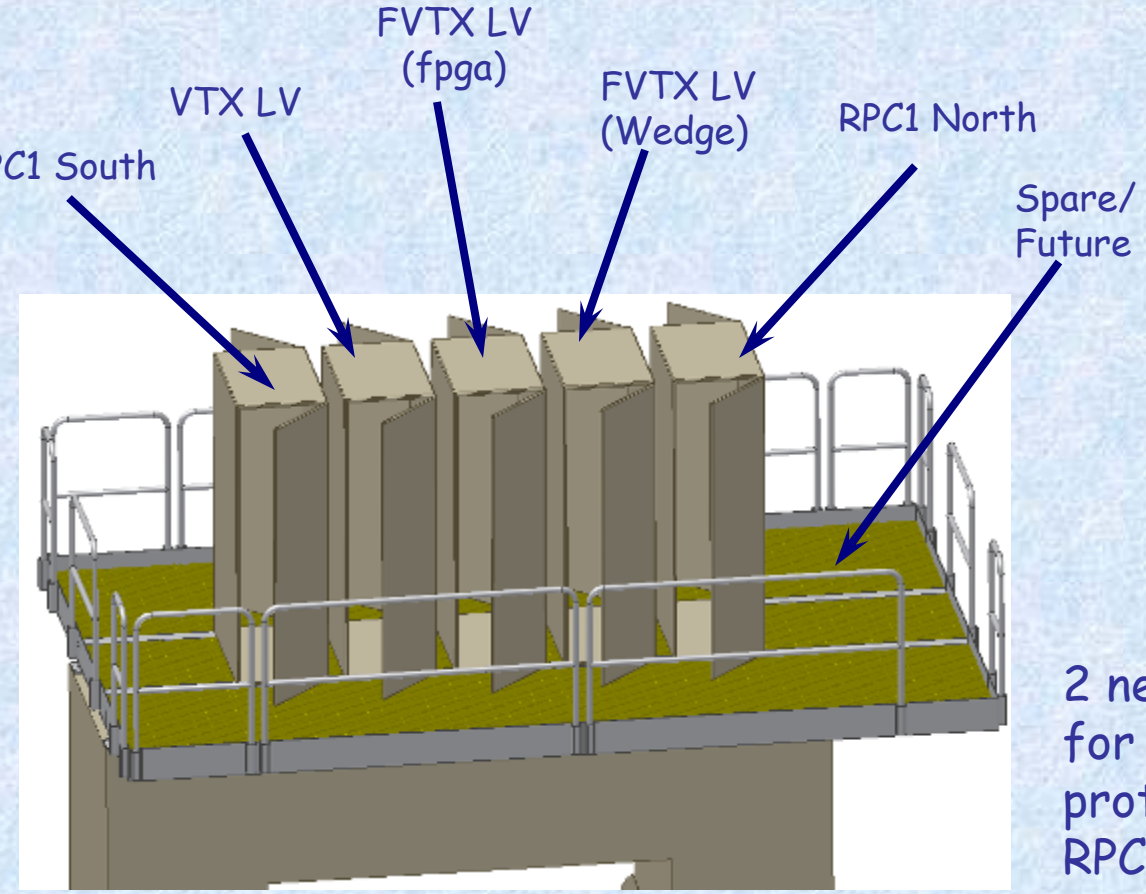
Currently each manifold feeds 4 modules
Plan is to add 2 flometers to the manifold to feed 2 modules each



Before

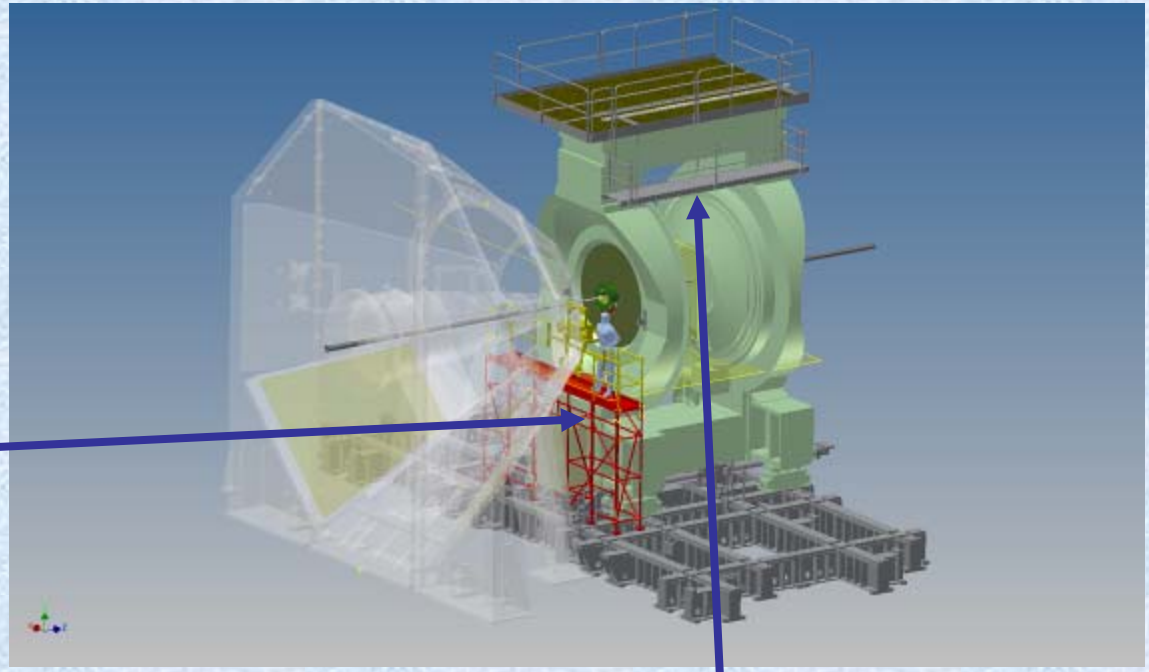


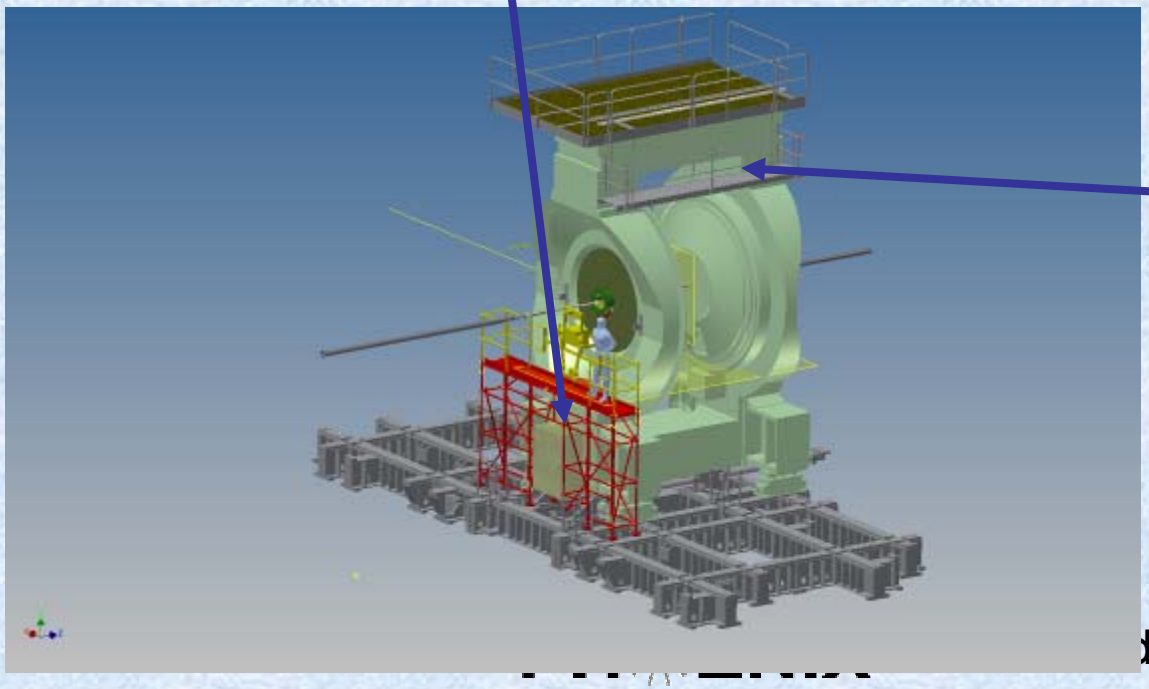
After



2 new racks to be added for FVTX, 1 new and prototype upgraded for RPC1. All racks will be equipped with standard PHENIX heat, smoke and water leak detection.

Station 1 platform configured for lower level access shown with North Muon Magnet in phantom for reference and invisible for clarity.

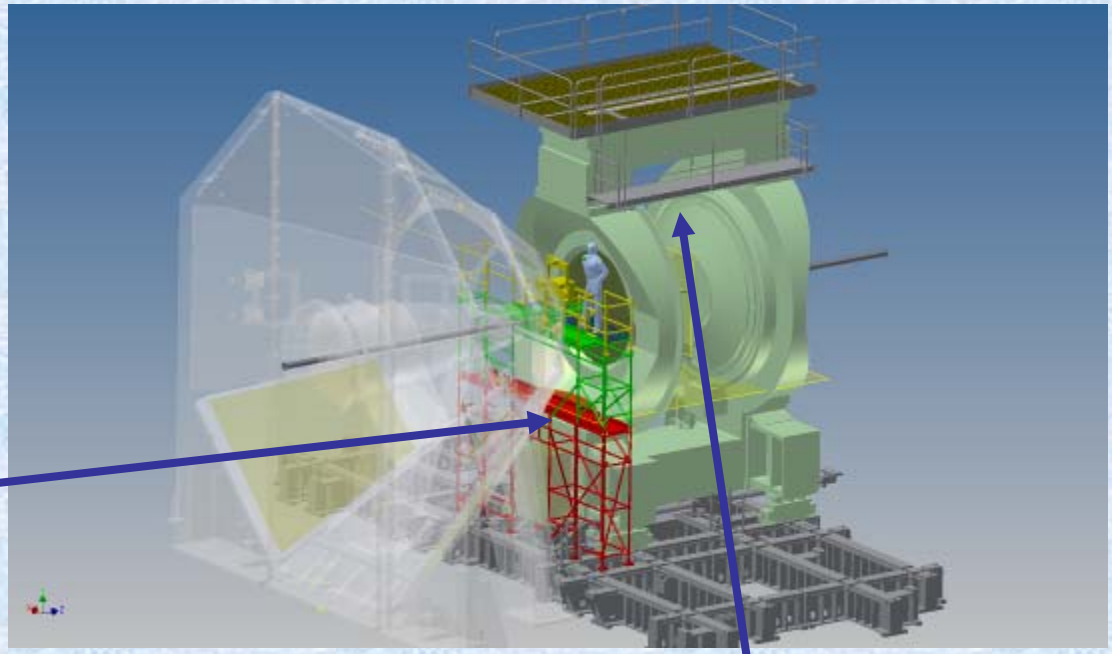


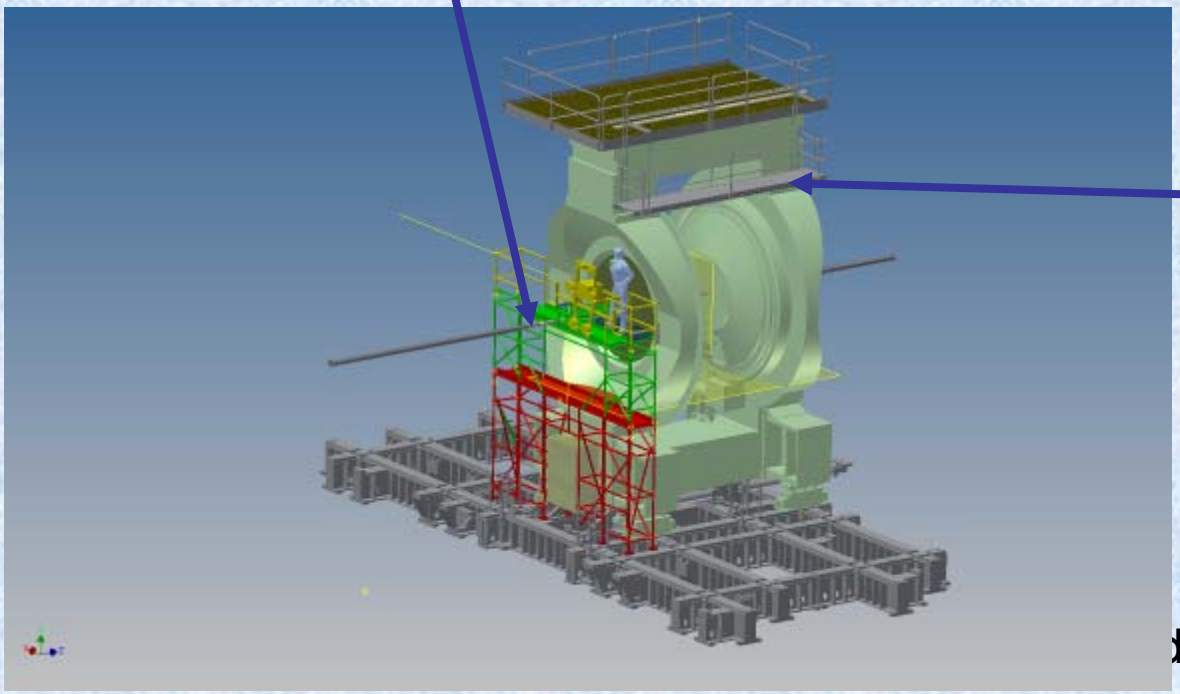


Central Magnet suspended work platform also shown in both models.

down

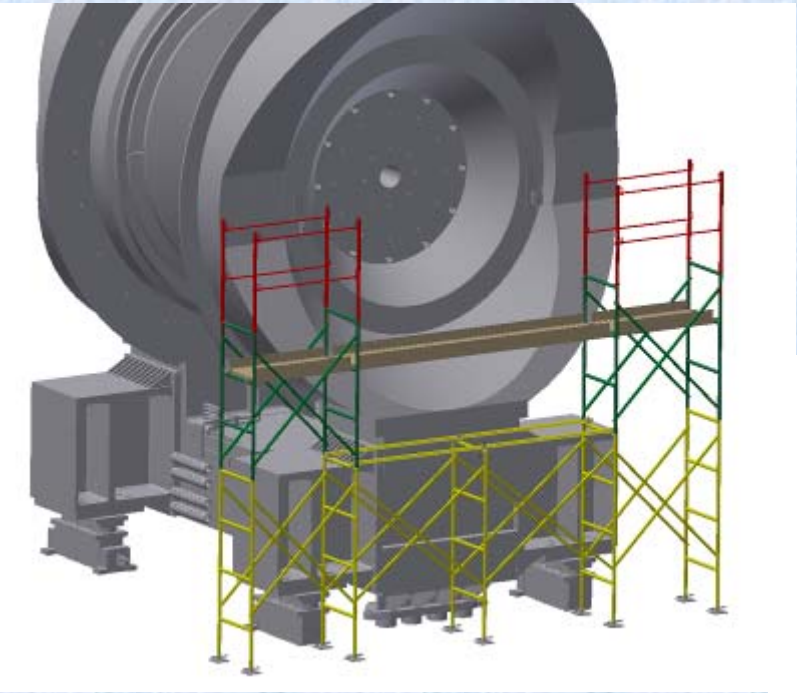
Station 1 platform configured for upper level access shown with North Muon Magnet in phantom for reference and invisible for clarity.

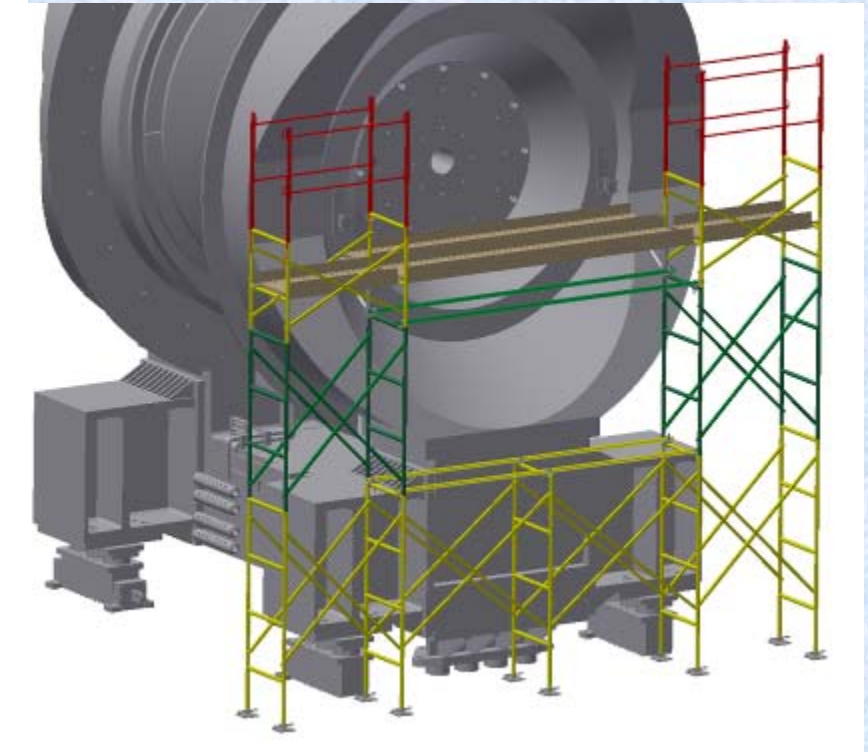




Central Magnet suspended work platform also shown in both models.

down





Station 1 scaffolding: redesigned to use SAFWAY pre-engineered free standing scaffold.